

NDE and Advanced Actuators for Space Applications at JPL

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ABSTRACT

Jet Propulsion Laboratory is responsible for the NASA unmanned deep space exploration programs. Under this responsibility, JPL is using various types of waves including microwave, radar, radio, and infrared to investigate distant planets. Besides remote imaging, JPL is increasingly conducting in-situ planetary exploration where miniature, miser, light and inexpensive telerobotic mechanisms are used to perform sampling and analysis tasks. The tasks are involved with harsh conditions, which are challenging the limits of existing technologies. The needs for effective NDE methods as well as actuators for planetary sampling tools are the subjects of the JPL NDEAA Technologies team R&D efforts. Various wave modes and electroactive materials are being investigated to develop a series of new devices and innovative mechanisms. This effort involves cooperation with scientists and engineers at such organizations as NASA Centers, universities, research institutes and industry. The initial efforts were focused on the development of NDE techniques, using ultrasonic Leaky Lamb Waves and Polar Backscattering. In the last 7 years, the efforts have evolved to other areas including actuation and robotics. The developed mechanisms and devices include ultrasonic motors and piezoelectric pumps that are driven by traveling flexural waves. An ultrasonic driller and corer is being developed that is driven by a piezoelectric actuator and its potential applicability at temperatures as high as 500°C is making attracting to such planets exploration as Venus. In parallel, electroactive polymers are being investigated for use as actuators that act similar to muscles. A dust wiper was developed that operates similar to a windshield wiper of an automobile and was selected as a baseline technology for a mission to an asteroid that will be launched in 2002. These devices and mechanisms as well as emerging medical applications will be reviewed in this presentation.

Biography

Dr. Yoseph Bar-Cohen is physicist with over 28 years experience in ultrasonic and electroactive devices. He is the JPL Resident NDE Expert and the Group Leader for the NDEAA Technologies (<http://ndea.jpl.nasa.gov/>). He is also an Adjunct Professor at the University of California, Los Angeles (UCLA) and a Fellow of ASNT. Since joining JPL in 1991, he has established state-of-the-art Nondestructive Evaluation (NDE) and Advance Actuators (AA) Labs. Currently, he is developing ultrasonic NDE methods and systems using plate wave analysis, geophysical probing techniques for coal mines, space-worthy high torque piezoelectric motors, a piezoelectric pump, electroactive polymer actuators, and high power ultrasonic techniques for medical applications. Dr. Bar-Cohen received his Ph.D. in physics (1979) and his M.Sc. in Materials Science (1973) from the Hebrew University at Jerusalem, Israel. Dr. Bar-Cohen pioneered several experimental ultrasonic techniques including his discovery of leaky Lamb waves (LLW) and polar backscattering in composite materials and co-developed the related NDE methods. He is the author of about 160 publications, made numerous presentations at national and international symposia and holds many patents.